SOLAR RADIATION AT THE SCRIPPS INSTITUTION, LA JOLLA, CALIF., 1928–34

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Since July 1, 1928, solar radiation observations have been made at the Scripps Institution of Oceanography of the University of California at La Jolla, Calif. At the suggestion of H. H. Kimball in July 1929, the radiation data were collected and dated in a manner that conformed to the practice at the insolation stations in the United States; and since that time the Scripps Institution has furnished radiation records to the Weather Bureau, which has published them in the MONTHLY WEATHER REVIEW.

The Scripps Institution became interested in measuring solar radiation because of investigations in evaporation rates of open bodies of water, seasonal weather forecasts, and the dynamical theory of ocean tides and currents. With insolation records for 6 years available, one may with confidence use an average daily or monthly value of daytime radiation.

The Scripps Institution is located geographically at longitude 117°15′ west and latitude 32°52′ north. The element is mounted on the roof of Ritter Hall, approximately 100 feet above sea level and 200 feet from the ocean high-tide mark. No structures on the roof interfere with radiation from the sun and sky. Moreover, but little if any smoke or dust is present in the air at this station.

Measurements of the total radiation on a horizontal surface received from the sun and sky are made by a calibrated Weather Bureau thermoelectric pyrheliometer, no. 17. In the laboratory an Engelhard microammeter register records insolation by drawing out a curve which starts at sunrise, moves up to a maximum near noon, and gradually returns to the zero base line at sunset.

The evaluation of daily total radiation is accomplished in three ways: (1) By multiplying by the proper constant the average ordinate of the insolation curve for a 20-minute period; (2) by moving the tracing arm of a polar planimeter about the curve; and (3) by using the new integrating machine which has been available since June 1934.

Table 1 gives the average monthly values of daytime radiation for a 6-year period, measured in gram calories per square centimeter per day on a horizontal surface. The average per day for the entire period is 351.

Table 2 gives the average hourly value of daytime radiation for each month of the 6-year period.

Recalibrations of the instrument, and its ability to give consistent results, indicated that its behavior was satisfactory during the 6-year period. For example, the total insolation measured during the complete years of 1929, 1930, 1931, 1932, and 1933 are in the ratios 43, 42, 41, 40, and 40, which is a rather constant proportion. However, the element is now being replaced by an Eppley instrument.

In tables 3 and 4, respectively, are given the average monthly ocean surface temperatures measured on the Scripps Institution pier, and the average monthly air temperature measured at Lindbergh Field in San Diego (10 miles south of the Scripps Institution).

A comparison of the results obtained in measuring insolation, ocean surface, and air temperatures is given in table 5. Figure 1 shows this relation graphically.

A 3-month lag is observed in the maximum ocean surface and air temperatures, which occur in August while the maximum insolation occurs in May. Minimum insolation occurs in December, while minimum ocean surface temperature was observed in January and February and minimum air temperature in January.

On several occasions attempts were made to measure insolation directly by means of photoelectric cells, such as the Burt sodium, the National carbon potassium, Bell Laboratory caesium, and the Weston photronic; for weeks at a time the current readings of the exposed photoelectric cells were taken and compared with the pyrheliometer values, but no simple linear relation existed between the cells and the pyrheliometer, or between different photoelectric cells. However, this failure should not be surprising when one considers how a certain photoelectric cell has selective absorption for only a small part of the visible radiation (different for each cell), while the pyrheliometer measures not only all of the visible but also all the invisible as well.

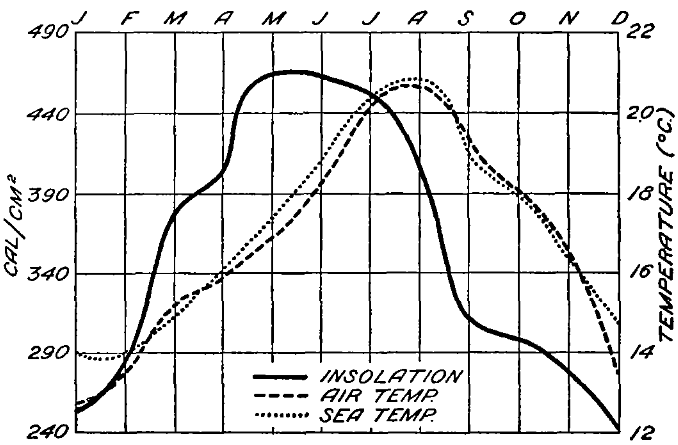

FIGURE 1.—Average monthly insolation, ocean surface temperature at La Jolla, and San Diego temperature, July 1, 1928–July 1, 1934, inclusive.

Measurements of insolation by means of small open-top insulated tanks gave excellent results. This method requires frequent measurements of losses and gains in heat through convection, conduction, radiation, and sensible heat, and losses through evaporation. The net number of calories gained by each square centimeter of the open-pan water surface is the insolation.

Although the 6-year records of radiation in La Jolla are of real value in physical, meteorological, and climatological studies, the records for a period of 12 years will be of even greater value, for this will cover the sunspot cycle, certain rainfall cycles, and certain atmospheric-pressure cycles over the Pacific Ocean.

TABLE 1.—*Average monthly values of daytime radiation measured in gram calories per square centimeter per day on a horizontal surface, Scripps Institution of Oceanography, La Jolla, July 1, 1928–July 1, 1934*

	1928	1929	1930	1931	1932	1933	1934	6-year monthly average
	gr. cal.	*gr. cal.*	*gr. cal.*	*gr. cal.*	*gr. cal.*	*gr. cal.*	*gr. cal.*	*gr. cal.*
January	--------	261.0	193.0	243.8	278.4	217.8	303.4	249.6
February	--------	312.2	256.2	274.4	283.4	294.3	292.3	285.5
March	--------	395.4	376.1	380.3	402.7	354.2	345.6	375.7
April	--------	403.0	416.1	364.7	448.7	321.7	488.9	407.2
May	--------	467.6	444.7	384.1	453.4	422.1	624.2	466.0
June	--------	449.5	437.5	462.9	478.5	409.0	523.0	460.1
July	545.1	452.4	476.6	495.0	406.6	329.6	--------	450.9
August	430.0	435.3	392.9	331.2	337.4	407.2	--------	389.0
September	293.0	295.0	364.9	349.1	232.9	328.4	--------	310.5
October	296.0	296.2	319.4	354.0	241.1	277.6	--------	297.4
November	291.0	288.3	260.6	260.4	241.1	322.0	--------	277.2
December	276.7	270.0	240.9	209.3	190.5	268.2	--------	242.6

TABLE 2.—*Average hourly values of daytime radiation measured in gram calories per square centimeter on a horizontal surface. Scripps Institution of Oceanography, La Jolla, July 1, 1934—July 1, 1934*

	Hour ending at—													
	A. M.						Noon	P. M.						
	6	7	8	9	10	11	12	1	2	3	4	5	6	7
	gr. cal.	*gr. cal.*	*gr. cal.*	*gr. cal.*	*gr. cal.*	*gr. cal.*	*gr. cal.*	*gr. cal.*	*gr. cal.*	*gr. cal.*	*gr. cal*	*gr. cal.*	*gr. cal.*	*gr. cal.*
January	----	----	3.5	14.1	24.9	35.0	39.7	44.1	36.6	28.2	17.3	6.7	0.4	----
February	----	0.3	5.4	15.5	25.5	35.4	40.4	41.0	39.2	34.2	23.8	11.5	2.2	0.1
March	----	2.5	12.0	24.0	36.4	44.6	49.7	51.6	48.1	42.0	31.0	16.5	4.9	.2
April	1.0	6.4	20.0	29.9	41.3	51.6	57.2	56.9	52.8	46.2	35.2	20.4	8.0	.8
May	2.0	9.6	19.6	31.1	42.1	53.3	60.7	61.6	56.1	48.2	38.3	24.2	10.8	1.8
June	2.3	8.7	17.4	29.9	40.5	49.7	56.1	58.6	54.6	48.3	39.3	26.0	12.4	2.7
July	1.6	6.5	15.1	27.3	38.5	48.3	54.3	54.9	51.2	44.8	35.5	22.7	11.1	2.5
August	.9	5.9	15.2	25.9	37.3	46.2	51.9	52.3	48.9	41.9	32.2	19.5	8.3	.9
September	.2	3.7	10.7	19.5	30.1	39.3	45.0	45.8	41.8	35.1	24.9	12.9	3.4	.1
October	.1	2.9	10.2	20.8	31.2	38.2	42.0	42.3	37.7	30.0	18.1	7.0	.6	----
November	----	.8	8.6	20.0	31.4	38.2	41.8	40.9	33.7	24.9	15.3	5.0	.7	----
December	----	----	4.4	15.7	25.4	33.1	36.2	36.2	32.0	22.3	12.5	3.0	----	----
6-year hourly average of daytime radiation	.7	3.9	11.8	22.8	33.7	42.7	47.9	48.9	44.4	37.2	27.0	14.6	5.2	.8

TABLE 3.—*Average monthly values of the ocean surface temperature measured in degrees Centigrade, Scripps Institution of Oceanography Pier, La Jolla, Calif., July 1, 1928–July 1, 1934*

	1928	1929	1930	1931	1932	1933	1934	6-year monthly average
	° *C.*	° *C.*	° *C.*	° *C.*	° *C.*	° *C.*	° *C.*	° *C.*
January	----	13.9	14.7	15.3	13.3	13.0	13.3	14.0
February	----	13.3	14.8	16.1	13.3	12.6	14.0	14.0
March	----	13.8	14.9	16.8	14.8	13.5	15.7	14.9
April	----	14.5	16.6	18.0	14.8	14.9	17.3	16.0
May	----	17.6	17.2	19.0	16.1	15.4	19.2	17.4
June	----	18.7	18.7	20.0	19.0	17.3	16.1	18.8
July	19.8	21.3	19.4	23.7	19.5	18.7	----	20.4
August	20.1	21.9	21.6	23.3	18.8	19.0	----	20.8
September	18.1	20.0	19.7	20.1	18.6	17.0	----	18.9
October	17.4	18.5	18.1	18.8	17.4	17.0	----	17.9
November	15.7	16.8	17.5	16.5	16.2	15.4	----	16.3
December	14.6	16.0	16.2	14.1	14.0	13.9	----	14.7

TABLE 4.—*Average monthly air temperature at San Diego, Calif., measured in degrees Centigrade, July 1, 1928–July 1, 1934*

	1928	1929	1930	1931	1932	1933	1934	6-year monthly average
	° *C.*	° *C.*	° *C.*	° *C.*	° *C.*	° *C.*	° *C.*	° *C.*
January	----	12.5	13.2	14.3	11.2	11.6	13.4	12.7
February	----	11.8	14.4	15.1	13.1	11.5	14.6	13.4
March	----	13.1	15.4	16.6	15.0	13.9	16.6	15.1
April	----	14.2	16.7	17.7	15.7	14.3	16.8	15.9
May	----	17.1	15.6	19.0	16.6	14.6	18.2	16.9
June	----	18.5	18.1	20.4	17.7	16.5	17.8	18.2
July	19.2	20.8	20.9	23.1	18.7	18.6	----	20.2
August	19.6	22.2	21.3	23.2	18.9	19.2	----	20.7
September	19.0	20.1	19.4	21.0	18.7	17.1	----	19.2
October	16.8	19.3	18.2	19.2	17.3	16.9	----	18.0
November	15.7	16.7	17.2	14.2	17.9	17.3	----	16.5
December	13.4	15.7	13.9	12.1	12.4	12.8	----	13.3

TABLE 5.—*Average monthly daytime radiation in La Jolla, Calif., ocean surface temperatures at La Jolla, air temperatures in San Diego, July 1, 1928–July 1, 1934*

	La Jolla radiation	Surface temperatures, La Jolla	San Diego air temperatures
	gr. cal.	° *C.*	° *C.*
January	249.6	14.0	12.7
February	285.5	14.0	13.4
March	375.7	14.9	15.1
April	407.2	16.0	15.9
May	466.0	17.4	16.9
June	460.1	18.8	18.2
July	450.9	20.4	20.2
August	389.0	20.8	20.7
September	310.5	18.9	19.2
October	297.4	17.9	18.0
November	277.2	16.3	16.5
December	242.6	14.7	13.3

THE TEMPERATURES OF NEW ENGLAND [1]

By PHIL E. CHURCH

New England occupies about 66,000 square miles of the eastern margin of the continent between the parallels of 41° N. and 47° N.

Within this area are various types of relief which have an influence on the temperatures. A slightly irregular coastal lowland borders a sinuous coast. Hilly sections form the transition zone between the coastal lowland and the mountainous regions inland.

The backbone of New England is the mountainous northeastward extension of the Appalachian Mountain system. In western Massachusetts it forms the Berkshire Hills, in Vermont the Green Nountains, in New Hampshire the White Mountains, a continuation of which to the northeast is part of the Maine-Quebec boundary. No definite ranges make up the highlands of northern and western Maine. In various places the mountains of New England rise to moderate heights: Mount Greylock in western Massachusetts, 3,535 feet; Mount Mansfield in Vermont, 4,389 feet; Mount Monadnock in southern New Hampshire, 3,166 feet; Mount Washington, the highest in the Presidential Range and New England, 6,293, with several others nearby having an altitude over

[1] Abstract of a thesis presented in partial fulfillment of the degree of master of arts at Clark University, under the supervision of Prof. Charles F. Brooks.